THE KANSAS UNIVERSITY SCIENCE BULLETIN.

Vol. IV, No. 18—September, 1908.
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CONTENTS:

LABORATORY METHODS IN EMBRYOLOGY, II, ... *R. G. Hoskins.*

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SOME LABORATORY METHODS IN EMBRYOLOGY, II,

INCLUDING A DESCRIPTION OF A SIMPLE PARAFFIN-BATH AND A NEW STYLE OF SECTION-KNIFE.

BY R. G. HOSKINS.

(Contribution from the Zoölogical Laboratory, No. 185.)

One figure.

IN a previous paper* was given a summary of the technical methods used in dealing with embryological material in the laboratories of the University of Kansas. The subject of holoblastic cleavage material, however, was not treated in detail. This paper is largely an attempt to remedy that deficiency. The methods are given in some detail, as the difficulties of handling this sort of material lie mainly in the minutiæ. No attempt to assign specific credit is made; the methods are the result partly of suggestions from the literature on technique, partly of suggestions by Doctor McClung and partly the outcome of experimentation by the writer.

For illustrating holoblastic cleavages, frog and salamander eggs are used. For studying the whole eggs the latter are more satisfactory on account of their having less pigment; for sectioning they are about equally good.

Various methods of making whole mounts were tried—using both glycerin-jelly and balsam. It was found that, on account of the difficulties of sealing glycerin-jelly mounts, balsam is decidedly the more satisfactory. The eggs are first fixed in four per cent. formalin, which hardens them slightly, but leaves the gelatinous matrix that surrounds them unchanged. The removal of this envelope follows next. This is rather a baffling or decidedly an easy matter, depending upon the method used. The best way is simply to roll the eggs over

* "Some Laboratory Methods in Embryology," Kan. Univ. Sci. Bull. IV, 4.

rough bibulous paper until the envelope is left behind; if carefully done, the eggs quickly roll out onto the paper uninjured. They can then be placed directly in strong alcohol, preferably 98 per cent. This is better than using successive grades of alcohol, as it saves time, reduces the dangers of handling and causes no appreciable distortion. The eggs are then cleared in creosote or turpentine and are ready to mount. These oils are preferable to xylol as they leave the material less friable. A few drops of thick balsam are placed on a slide, and one or more eggs, after being rinsed with xylol, are laid on this and allowed to sink into it. The balsam should be thick enough to form a mass of sufficient depth entirely to submerge the eggs, as, otherwise, if any of the gelatinous matrix is left upon them, it takes up minute air-bubbles as drying proceeds. If care has been taken to select only eggs that orient themselves satisfactorily in the preserving fluid, this same orientation will be maintained in the balsam mount. This is rather an important precaution, as, without it, the eggs are likely, before the mount is dry, to take an unsatisfactory position that can not well be remedied. The eggs may be mounted either singly or in a series with about equal ease.

After the balsam has hardened enough to hold the eggs firmly *in situ*—one or two days—a protecting cover is placed upon them. An ordinary cover-glass, supported on bits of glass, can be used by putting it in place and filling in with balsam from one side. A little xylol should be run over the balsam just before the cover-glass is put in place, to avoid getting air-bubbles into the mount. Rather a more satisfactory covering, however, is a small watch-crystal, 10 or 15 mm. in diameter, the size depending upon the number of eggs on the slide. A drop of xylol is put into the crystal, which is then filled rounding full of thick balsam. Another drop or two of xylol is poured over it and any air-bubbles present removed. Then the slide holding the eggs in their balsam matrix is similarly moistened with xylol and inverted onto the watch-crystal so as to enclose the eggs. The convexity of the matrix does away with the chief difficulty of watch-crystal mounts—the tendency of the fluid to run out sidewise, thus introducing air. The mount is now ready to set aside to harden; care must be taken, however, that a good ring of balsam entirely surrounds the edge of the crystal so that air cannot be drawn in as the balsam dries.

For sectioning, the eggs should be removed from their matrices and fixed in picro-sulfuric or some other good fixative. Four per cent. formalin does not give good results except for whole mounts, but probably ten per cent. would prove more satisfactory. The extreme friability of the yolk material makes the eggs difficult to section by ordinary methods. This can be done easily, however, as follows: The eggs are cleared in turpentine, then infiltrated with paraffin melting at about 54 degrees. They are then removed from the paraffin-bath, *and the paraffin allowed to harden.* Afterwards they are placed for a short time in 62-degree paraffin, so that the superficial elements may become infiltrated with it, while the yolk material is impregnated with the softer paraffin. This leaves the eggs in sufficiently homogeneous condition to section well. The blocks should first be cooled thoroughly, and then sectioned quickly in a rather highly heated room so that only the outer part of the paraffin becomes heated enough to permit the sections to "ribbon." In this way the development of disastrous stresses due to the disparity in consistency between the various elements of the section is prevented. An electric-light bulb suspended directly above the block and near enough to warm one side of it facilitates matters by causing the paraffin to ribbon better.

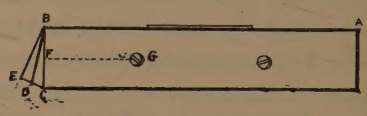
For staining the sections, either Zwaardemaker's safranin or hæm-alum and orange G. can be used, but almost any good nuclear stain will do.

Incidentally, it might be well at this point to refer to the infiltrating apparatus used. It consists only of a fifty-candle-power electric bulb suspended over the paraffin contained in an ordinary glass tumbler or Stender dish. Its advantages over the ordinary kinds of paraffin-baths are obvious. It is entirely simple and the material is always infiltrated at the lowest possible temperature—that of the barely melted paraffin of the layer just above the solid part upon which it rests. A bulb of lower candle-power can be used if a reflector is added to concentrate the heat. Only the paraffin in the upper part of the container should be melted. This can be regulated by raising or lowering the electric bulb.

Opportunity may be taken at this point to mention also a section-knife that Doctor McClung, of this department, has recently devised. Its purpose is to do away with the trouble incident to keeping an ordinary knife in good condition. It

consists of a holder for an ordinary safety-razor blade and is made as follows: Two pieces of steel are used as supports; they are in shape, in cross-section, plain wedges, as shown in the accompanying illustration. The inner faces are planed to fit each other accurately, no allowance being made for the thickness of the razor-blade. To secure sufficient rigidity the supports should be as thick as the carrier of the microtome on which the knife is to be used will permit. The two parts of the support are held together by two screws, as illustrated, the screw-heads being countersunk so as to have bearing-surfaces parallel with the inner surfaces of the supports. The dimensions of the knife described are:

A—B, 126 mm.
B—D, 22 mm.
D—C, E—D, 5 mm. F—G, 18 mm.



The apparatus has been found in practice to work quite satisfactorily for the softer tissues, but is not sufficiently rigid for the denser ones, such as skin.

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NOTES ON SOME NORTHERN ARIZONA BIRDS, ... *Alex Wetmore.*

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NOTES ON SOME NORTHERN ARIZONA BIRDS.

BY ALEX WETMORE.

(Contribution from the Zoölogical Laboratory, No. 186.)

FROM February 24 to April 1, 1907, I was stationed at Williams, Ariz., a town of about 1200 inhabitants, on the main line of the Atchison, Topeka & Santa Fe coast lines. The elevation was 6700 feet, and the town itself is in a little hollow on the north slope of Bill Williams Mountain, which rose to an altitude of 10,000 feet. The whole country was of essentially volcanic origin, as numerous "cinders" (lava) and a few strongly alkaline "crater" lakes testified. At Crater Mountain, two miles northwest, part of the opening of an old volcanic cone could be traced. Directly south was a rocky canyon, called by some the Head of the Cataract, which drained the country toward the north and finally, grown deeper, joined the Grand Canyon of the Colorado river, under the more pretentious name of Cataract Canyon. The prevailing soil appeared to be a clay, usually of a reddish color, thickly strewn with loose stones, principally of quartzite, near Bill Williams Mountain.

The mountain itself rose approximately in three huge terraces, with the summit about eight miles from town. It was covered with snow all during my stay and I climbed only as far as the lower edge of the spruce belt because of this. To the east could be seen Kendricks, San Francisco, and Sitgreaves Mountains, in the order named, forming an imposing trio, with the largest in the center.

The yellow pines (*Pinus ponderosa*) abounded, with spruce occurring toward the summit of the mountain, while to the north scattered cedars and piñons could be found. The avifauna was Canadian, with transition zone species occurring in the piñons and on the open plains.

The weather, taken as a whole, was very good during my stay. It snowed at least once every week and sometimes twice, but six inches of snow lasted only a day or two and did not seriously interrupt my field-work. The days were usually as clear as possible, however, with scarcely a cloud in the sky. There was great variation of temperature between night and day, from +30 deg. Fahr. at four A. M. to +70 deg. at noon being about an average. By the end of the first week in March signs of migrational activity were noticed, and by April 1, the time of my departure, nearly all of the earlier species of birds had come.

The following notes are based on a collection of 170 specimens, representing 39 species. As there are so few of them I have given in its proper place the date when each was taken.

I wish to thank Mr. Oberholser for correcting my identification of the horned lark taken.

1. *Buteo borealis calurus* (Cass.)—WESTERN RED-TAILED HAWK. A *Buteo,* presumably this species, was heard screaming on the side of the mountain February 26. On March 11 I found a pair of these red-tails about three miles west of town, near Supai. They were rather wild, but must have picked on a location for a nest, as they always returned to one locality.

2. *Falco sparverius deserticola* Mearns.—DESERT SPARROW HAWK. Five adult males, taken on the following dates: March 13; March 21, two; March 29, two. First seen March 13, and became more and more common toward the end of my stay. One bird had a mouse of the genus *Microtus* in its talons when shot. These little hawks were very tame and heedless. One that I saw flew into a pine tree and perched out of sight on the opposite side of the bole, screaming shrilly. I circled round looking for it, but it was several minutes before I discovered the bird, as it sat crouched down on a big limb with its head towards me, looking like a twisted branch and evidently relying on its protective coloration to escape attention.

3. *Dryobates villosus hyloscopus* (Cab.)—CABANIS WOODPECKER. One male, taken March 19. Two females, taken March 2 and 8. Not very common. Were so wild that it was hard to get near them. They were found among the pines, and sometimes I would follow one nearly a mile, only to have it start out at last and fly until it was out of sight in the distance.

4. *Sphyrapicus varius nuchalis* Baird.—RED-NAPED SAPSUCKER. Two adult males, March 11 and March 29; one adult female, March 17. One of the male specimens has the red on the throat extending much farther over the black of the upper breast than the other, while in the female the chin is white and the throat only is red. First seen March 11, when one was taken near Supai. The stomach was empty, and as it was about nine A. M I think the bird had just come. Later they became fairly common. The female, shot near Rollins Lake March 17, had tapped a pine tree near an old ax-cut, and the stomach was filled with ants. The birds gave the weak *Keh-a* note of the eastern variety, but had not become very noisy yet at the time of my departure.

5. *Syphyrapicus thyroideus* (Cass.) — WILLIAMSON SAPSUCKER. One adult male, taken March 8. Only one of these birds was seen. It flew into a pine and kept so well concealed that it was some time before I could get sight of it.

6. *Melanerpes formicivorus* (Swains). — ANT-EATING WOODPECKER. Three adult males, March 8, 19 and 25. A number of these birds were seen in rather open woods on the side of Bill Williams Mountain. They invariably perched on the tops of the tallest dead trees, and flew high in the air from one point to another, quite a different habit from what I had observed in the California variety. Beside the usual *ja-cob* I heard them give a rattling note similar to that of *Melanerpes erythrocephalous*. The plumage in the birds taken is very soft and thick, and I am of the opinion from this that they had spent the winter here.

7. *Melanerpes torquatus* (Wils.) — LEWIS WOODPECKER. One adult male, March 25; two adult females, March 13. The male has red on the anterior portion of the head more extensively, but otherwise resembles the females. These birds were rather common in sheltered localities around Crater Mountain. I found them in pairs sitting out of the wind on the dead tree-tops. They were wary and hard to secure. The flight was direct and flapping, like that of a jay, entirely different from the free, bounding flight of most of the woodpeckers, while their long black wings gave them a crow-like appearance. I have never heard them make a noise of any kind except once, when one that I had winged gave a harsh screaming note.

8. *Otocoris alpestris leucolæma* (Coues).—PALLID HORNED

LARK. One adult male, taken March 29, has been referred to this form by Mr. H. C. Oberholser. A number were found on this date on an offshoot of the Coconino plains northeast of Williams. They were silent, and hard to find, because of their protective coloration.

9. *Cyanocitta stelleri diademata* (Bonap.)—LONG-CRESTED JAY. Five adult males, February 24, February 26; two March 8, March 13. Three adult females, March 13, 17 and 21. Common everywhere in the pines. Found in flocks, usually on the side of the mountain. They were rather wary and kept ahead of me in the woods, but when I could manage to catch up with them they seemed to rely on the thick branches of the pines for concealment. This would have been sufficient had the birds been able to remain quiet, but they were continually moving about and screaming and so exposed themselves. They began to mate before I left, and I think from their actions that a few pairs had already begun building. These jays usually kept to themselves, though I found a few of them with flocks of *Cyanocephalous cyanocephalous*.

10. *Aphelocoma woodhouseii* (Baird).—WOODHOUSE JAY. One adult male, March 13. One or two small flocks of this species were found in the piñons on Crater Mountain but were very wild. They had the same flat, rapidly given note as *Aphelocoma californica*, and reminded me of that bird in their actions. Whenever I saw them they were always out of range and slipped away through the piñons so fast that I could not get near them.

11. *Cyanocephalous cyanocephalous* (Weid.)—PIÑON JAY. Two adult males, March 29; three adult females, March 8, 13 and 29. Common in suitable localities in the piñons. Williams was about the highest point that they were found on the mountain, as they never got far away from the piñons. Until the end of my stay they were very wild, and sometimes I would follow a flock through the pines for fifteen minutes with their strange querulous notes continually sounding just ahead of me, without even catching sight of one. One female, shot March 8, contained a fully developed egg, but the greater number of the birds had just begun to pair on my departure. The last day or two they were not so wild. I found them feeding on the ground then, and when frightened they flew up only into the dead limbs of the trees to give their queer, half-laughing

notes. Even in the small series taken there is considerable variation in the depth of coloring. This may be due to age, the darkest ones being the young of the previous year, as the nesting female taken, which was presumably adult the previous year, is paler colored than any of the others.

12. *Sturnella magna hoopesi* Stone.—TEXAS MEADOWLARK. Three adult males, March 17, and March 29, two. One adult female, March 29. These birds are typical *S. magna hoopesi*, and this record extends their range, as given by Ridgway (Birds of North and Middle America, part II, p. 361), from southern Arizona to about 200 miles farther north. They were first seen March 17 and became fairly common later. I found these birds on a narrow neck of the Coconino plains, and became certain at once that they were not *Sturnella neglecta*. The song resembled that of our eastern *Sturnella magna* very closely, and was nothing like that of *S. neglecta*. These birds also had the same sputtering call-note of the eastern variety. In coloration the four specimens taken average as light as *S. neglecta* from Oklahoma, taken in January, and from western Kansas, taken in October. The black bars on the tertials and middle rectrices are separate in three specimens and nearly so in the fourth. There is no yellow on the maxillary region at all, and the yellow on the underparts is deeper than in *S. magna*, having a slight orange tinge. The female has the yellow of the under parts restricted to the median line and much obscured by the buffy tips of the feathers.

The measurements are as follows, taken in millimeters:

	Length.	Wing.	Tail.	Exposed culmen.	Tarsus.
No. 2655, male adult, March 17.....	231	120	67	31	38
No. 2715, male adult, March 29.....	228	115	66	31.5	36
No. 2716, male adult, March 29.....	228	120	71	31	36
No. 2717, female adult, March 29.....	221	109	61	30	35

13. *Carpodacus cassini* Baird.—CASSIN FINCH. Five males, adult and immature, March 11, March 19; March 31, three; five adult females, March 11, four; March 19. One immature male taken differs from the females in slightly darker olive back with darker and more sharply defined streakings above and below. Fairly common after March 11, on the side of Bill Williams Mountain. They were usually a little wild and difficult to approach. One day I found a flock of about fifty scattered through the pines on a level bench high up on the mountain, singing in chorus, as so many of the *Fringillidæ* do.

The song, a sweet warble, like that of *Carpodacus purpureus*, but softer and with not so much carrying power, fitted in well with the babblings of dozens of little brooks carrying away the melted-snow water. The ordinary call-note was a single dull note, not at all metallic. Frequently I found the birds feeding on the ground in the shelter of the low pines, in company with various sparrows.

14. *Carpodacus mexicanus frontalis* (Say).—HOUSE FINCH. One immature male, February 26. One flock of about twenty-five frequented the edge of town and had probably been there all winter. Sometimes there were pine siskins and cassin finches with them. Usually I found them feeding on the ground and they would fly up on my approach to light either in a brush-pile or on a low tree.

15. *Loxia curvirostra stricklandi* Ridgw.—MEXICAN CROSSBILL. Seven males, adult and immature, February 26; March 2, two; March 8, two; March 17, two. Two adult females, February 26, March 17. The males are variously intermediate between the golden and the full red plumage, while one of the females is much brighter than the others, having traces of orange on the sides of the breast and the rump. Of the nine specimens before me, six have the mandible crossed to the left and three to the right. These birds were common in the pines and were evidently breeding, though no nests were found. The last of June I saw them feeding young birds near the Anita copper-mine, about forty-five miles north of Williams. They were feeding, in the spring, on the pine-cones. They were very wild and erratic in their movements, and so were hard to get. Frequently I saw them flying over, high in the air, giving their steely *kimp, kimp*. Early one frosty morning a male was found sitting in the top of a dead tree in the sun, preening his feathers. A little brook of snow-water that ran through the pines near Rollins Lake was a favorite place with them for drinking and bathing.

16. *Spinus pinus* (Wils.)—PINE SISKIN. Four males, adult and immature, February 24; February 26; and March 25, two; March 25, two adult females. There is considerable difference in definiteness of the streaks on the under parts and also in the color of the specimens. In some the colors are very clear, with sharply marked streaks on the under parts, but in others the colors, especially on the under parts, are duller, with

the streaking more indefinite and obscure. The adult males have the yellow on the primaries and rectrices very bright. Compared with specimens taken in the fall in central Wisconsin, the olive of the upper parts is darker, and below the streaks are a little longer in these skins. Measurements appear to be the same. Fairly common, in flocks ranging from a dozen to fifty. One morning I found an adult and an immature male sitting together in a bush, the former singing a simple twittering song. In flocks they are rather silent, though when startled their loud *che-a* is given. In town a flock of about thirty fed every day in a vacant lot, paying no attention to people on the sidewalks. They fed in close order, apparently heedless of danger, and when startled usually flew a few feet only. A favorite perch was a telephone-wire when they were through feeding. The latter part of June I found them feeding their young in the streets of Williams, but when I left, in April, they had shown as yet no signs of mating.

17. *Passer domesticus* (Linn).—ENGLISH SPARROW. Not noticed until the latter part of March, when a single male was seen. There were a few around Flagstaff, twenty-five miles east, and I think this one came from there. The evening before a freight had picked up two cars of stulls (timbers for the mines) at Flagstaff after dark, and had set them out at Williams. The next morning, just at daylight, I saw the sparrow sitting on one of the cars calling, and got up to within a few feet of it. It is possible that the bird had gone to roost in these stulls the night before at Flagstaff, and had been carried over in this way, though of course it could have flown the distance during the night. In June I saw a pair in the town, so that the species had evidently gained a foothold there.

18. *Poœcetes gramineus confinis* Baird.—WESTERN VESPER SPARROW. Three adult males, March 17. One adult female, March 29. Found in the open around the Crater lakes; especially common on the east side of Rollins Lake, and a number seen near a lake west of Crater Mountain. First seen March 17, and common from then on. This subspecies had the same habits as the eastern bird. The only note I heard them give was a faint *tseet*. They fed on the ground among the broken rocks and were hard to find, but when forced to flight they usually lit on a rock, so that they were easily taken. During a heavy wind it was almost impossible to make them fly.

19. *Junco hyemalis* (Linn).—SLATE-COLORED JUNCO. One adult male and one immature male, February 26 and March 25. Taken from mixed flocks of juncos.

20. *Junco mearnsi* Ridgway. — PINK-SIDED JUNCO. Two adult males, February 26 and March 13. Taken mixed in with the other forms of *Junco* on the side of the mountain.

21. *Junco annectens* Baird.—RIDGWAY JUNCO. One male adult, March 8. Ridgway (Birds of North and Middle America, pt. I) calls this "species" a hybrid, *Junco caniceps* x *Junco mearnsi.* It was taken from a flock and its identity not noticed till later. The flanks are very strongly tinged with pink, and there is a little brownish wash on the tertials and greater wing coverts. The measurements taken from the skin are as follows:

	Length.	Wing.	Tail.	Culmen.	Tarsus.
No. 2616, male adult, March 8.....	150	83	73	11	21

22. *Junco caniceps* (Woodh.)—GRAY-HEADED JUNCO. Seven adult males, February 23; March 2, three; March 4, two; March 11. One adult female, March 11. In the field this bird could not be separated from *Junco dorsalis,* and in fact it was almost impossible to name any of the species of *Junco* present here, unless they were in the hand. When I first came these birds were found only in the shelter of the low pines, but as the migration began they became common everywhere.

23. *Junco dorsalis* (Henry). — RED-BACKED JUNCO. Nine adult males, February 23, March 2; March 8; March 11; March 19, two; March 21, three. One adult female, March 11. This species, together with *Junco caniceps,* formed the bulk of the juncos seen. The two species were mixed together, and examples of the others were also found in the same flocks, so that identification without the gun was impossible. When I first arrived there were only a few present, and I found them roosting in the low pines on the side of the mountain. After the first week in March they became more common, and were scattered in small flocks all up and down the mountainside, and, as they became more numerous, also spread to favorable situations on the level. When disturbed on the mountain, they flew up into the trees with the usual junco call-notes, and moved rapidly along up the slopes. They usually came back after a few minutes, seeking a lower level. On cold, windy days, they fed in the shelter of numerous deadfalls, from which it was almost impossible to flush them. *Junco dorsalis* gave a

simple twittering song with either three, four, or five notes, like *tsee, tsee, tsee, tsee.* This song was given either from an exposed perch or from the shelter of a piñon, in which it was difficult to find the bird. The last *Junco caniceps* was taken March 11, and I do not think many remained to breed. *Junco dorsalis* was found commonly after this, the last one being taken March 21, but what I took to be this species was seen till the end of my stay. They were then distributed all through the deadfalls on the mountain, and were apparently preparing to breed.

24. *Junco oregonus shufeldti* (Coale).—SHUFELDT JUNCO. Six adult males, February 26, March 2, two; March 4, 11 and 13. These juncos had the habits of the other species, but could be distinguished in the field by their black heads. There were a few present on my arrival, but none were taken after March 13, and I think they were about all gone then.

25. *Pipilo maculatus megalonyx* (Baird).—SPURRED TOWHEE. One adult male, March 8; one adult female, March 13. First seen March 8, but was common by the middle of March. They frequented the brush-covered hillsides, mounting to the tops of the branches to sing, but when I appeared dropped to the ground and ran off into cover. Frequently I hunted for more than half an hour without getting more than a glimpse of one.

26. *Tachycineta thassalina lepida* (Mearns). — NORTHERN VIOLET-GREEN SWALLOW. Five adult females, March 29. On this day I found a flock of about twenty of these birds in a wash between two hills northeast. They were feeding on the wing, calling *chu, chu* in a peculiar tone. When tired they rested on the dead limbs of the trees, but were soon flying around again. All those taken were females, but they were playing in the air as though mating.

27. *Lanius ludovicianus excubitorides* (Swains).—WHITE-RUMPED SHRIKE. One adult male taken, March 25. This bird was shot along the railroad-track, and was the only one seen. It is a well-marked specimen of *L. ludovicianus excubitorides,* and resembles others from Kansas and Wyoming.

28. *Oroscoptes montanus* (Towns.)—SAGE THRASHER. One adult male, March 31. One found skulking in the bushes near the foot of the mountain-slope.

29. *Salpinctes obsoletus* (Say).—ROCK WREN. Four adult

males, March 21; three March 29. First seen March 21 and afterward common. In June I found a nest containing four young, built underneath a stone in the canyon south of town. This species was found on rough, rocky ground, usually on the side of some knoll. They sang a great deal, and the song resembled that of a thrasher more than that of a wren. It consisted of separate notes, each one repeated three or four times, and then, after a pause, a repetition of a different one. The birds were rather hard to follow, though they kept bobbing up ahead of me everywhere. They were very nervous, and when sitting on a rock watching me kept jerking the body up and down.

30. *Catherpes mexicanus polioptilus* Oberholser.—INTERMEDIATE CANYON WREN. One male adult, March 21; one female adult, March 4. *Catherpes mexicanus polioptilus* from Arizona is, according to Ridgway, intermediate between *C. mexicanus conspersus* and *C. mexicanus mexicanus*. The two taken are almost identical in coloration with a specimen of *C. mexicanus punctulatus* from Summit, Cal., though the female is a trifle paler, and because of this I have referred them to this variety, though *C. mexicanus conspersus* should also occur here. These birds were seen in the canyon south of town, and were fairly common, but from their habits hard to find. They frequented broken rock and brush-piles, and would bob out for an instant to scold and then disappear. It was impossible to follow them, as I could never tell where they were coming up. They were usually found in pairs. Their song was a clear whistling note, repeated in a falling scale, and is one of the best that I know. It had great carrying power, and I frequently heard them singing in the morning on the mountain above town, a distance of a quarter of a mile or more. Sometimes the birds would mount into the top of a pine tree and sing for half an hour, but usually they chose some sheer rock-face in the canyon.

31. *Certhia familiaris montana* Ridgw.—ROCKY MOUNTAIN CREEPER. One adult male, March 8. This one bird, taken early one morning on Crater Mountain, was the only one seen. It came working rather rapidly down the side hill while I was watching a pair of gray titmice.

32. *Sitta carolinensis nelsoni* Mearns.—ROCKY MOUNTAIN NUTHATCH. Five adult males, February 26, March 2, 4. 11,

13; five adult females, February 26; March 4; three, March 13. Common everywhere in the timber. These birds had the same habits and notes as the eastern variety. I shot a female one day which hung in a tree, and a male came bustling around with spread wings and tail, and pecked and pulled at it until it fell to the ground. He seemed more curious than anything else, and not at all alarmed.

33. *Sitta pygmea* Vig. — PYGMY NUTHATCH. Nine adult males, February 23, March 4, 13, 19, 21; five adult females, February 23, 24, March 2, 13 and 21. This was the most common bird of the pines and was usually found in small flocks. They were very active, crawling up and down the tree-trunks or hunting through the limbs in regular warbler style, giving their soft, rather peevish notes continually. They frequently lit on a dead limb just above my head and scolded me vigorously. When the first warm weather came they began to mate, and paraded around in true nuthatch style with spread wings and tail.

34. *Bæolophus inornatus griseus* Ridgw.—GRAY TITMOUSE. One adult female, taken March 8. Seen only on this one day, when I found a pair by their harsh scolding notes on the side of Crater Mountain. The male gave a clear whistled *pete, pete, pete,* like that of *Bæolophus bicolor,* but having only one syllable instead of two. They were working rapidly through the brush, and when one was shot the other disappeared.

35. *Penthestes gambeli* Ridgw. — MOUNTAIN CHICKADEE. Six adult males, February 26; two, March 2, 8, 21 and 25. Four adult females, February 26, March 8, 11 and 17. Common. This species had the same habits and was found in the same localities as *Penthestes atricapillus* frequents in the east. The notes were harsher, like those given by the young of the eastern bird in July and August. I also heard them give a clear whistled *Phœ-be* with the last note sometimes repeated twice. They were very tame and appeared to pay no attention to me at all.

36. *Psaltriparus plumbeus* Baird. — LEAD-COLORED BUSH-BIT. Four adult males, March 25. Two adult females, March 25. One flock of about fifteen seen on Crater Mountain, feeding rapidly through the bushes. They were very quick and active, searching every nick of a limb. I heard them give three call-notes, two of them low and weak, like *tsit, tsit, tsee, tsee,*

and another louder, *tseeree.* The first one was kept up continually. They made a little disturbance over a little wounded bird, but by the time I had secured it they were all gone and I did not see them again. This species seems to be indistinguishable from those females of *Psaltriparus melanotis lloydi,* which lack the black on the head, but as the adult males of *P. plumbeus* were taken I have referred all the specimens to this form.

37. *Regulus calendula* (Linn).—RUBY-CROWNED KINGLET. Three adult males, March 19; two, March 25. A few of these were found during March. The last of June I heard a male singing in the spruces just below the summit of Bill Williams Mountain, at an elevation of 10,000 feet.

38. *Merula migratoria propinqua* Ridgw.—WESTERN ROBIN. Three adult males, March 11; two, March 21. Two adult females, March 11 and 21. The first ones seen were in a small flock in the pines near Supai. Later they became common, and were found in considerable numbers on a plateau south of town. Here they were rather wild, and when frightened usually lit in the numerous deadfalls.

39. *Sialia mexicana bairdii* Ridgw.—CHESTNUT-BACKED BLUEBIRD. Three adult males, March 2, 19 and 21; two adult females, March 8 and 17. These birds were first seen March 2, but were common a week later. They frequented the cut-over pine lands, where the numerous stubs furnished them perches. The only note I heard them give was a low *tur-wee,* like the fall note of *Sialia sialis.*

40. *Sialia arctica* Swains.—ARCTIC BLUEBIRD. One adult male, March 17. A few birds of this species were found in the same localities as the preceding one. A favorite place was near the shore of one of the numerous Crater lakes, and some of them were found in the town itself.